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NATIONAL PARK SERVICE
1849 C Street, N.W.
Washington, D.C. 20240

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FROM: CDR David Wong, MD
Team Lead
NPS Disease Outbreak Investigation Team

SUBJECT: **Rabies epizootic among gray foxes in the Flagstaff Area, Arizona: Considerations for a proposed oral rabies vaccination program**

TO: Diane Chung
Superintendent
Flagstaff Area Monuments

Rabies and Oral Rabies Vaccination (ORV)
Rabies is an acute, fatal viral disease of mammals that is most often transmitted through the bite of a rabid animal. Wildlife—including raccoons, skunks, bats, and foxes—are the primary disease reservoir in the U.S. and account for >90% of all animal rabies cases (Blanton et al 2008).

Since 1990, oral rabies vaccination (ORV) programs in the U.S. have been an important strategy for containing the spread of rabies among wildlife and limiting potential exposures with humans. Such programs are primarily funded and managed by the U.S. Department of Agriculture (USDA) Animal and Plant Health Inspection Service-Wildlife Services (APHIS-WS). Currently, there are 16 states distributing ORV baits for raccoons, and one state (Texas) distributing ORV baits for gray foxes and coyotes (USDA APHIS-WS 2009).

APHIS-WS has written two broad-scale environmental assessments (EAs) regarding the use of ORV in the U.S. These EAs were written to satisfy National Environmental Policy Act (NEPA) compliance requirements for the following states: AL, FL, GA, KY, ME, NH, NY, OH, PA, TN, TX, VA, VT, WV, and to cooperate in smaller-scale ORV projects in MA, MD, and NJ. In addition, six networks of NPS units encompassing more than 50 NPS units have written EAs for ORV use. When analyzed through the NEPA review process, each of the previous USDA and NPS EAs has returned a finding of no significant impact (FONSI). NPS involvement with ORV began in 2002 with a guidance memo to parks from Director Mainella (http://inside.nps.gov/publichealth/zed/rabies/rabies_letter.pdf).

Rabies in the Flagstaff Area, Arizona
Arizona is currently experiencing a statewide rabies epizootic of record proportions. During January 1—May 29, 2009, a total of 23 rabies-positive animals (17 gray foxes, 5 skunks, and 1 ringtail) have been confirmed in the Flagstaff area, a greater than 3-fold increase compared to 7

rabies cases for all of 2008 (Figure 1a-b). Previously, the Flagstaff area had experienced skunk rabies epizootics in 2001 (19 cases) and 2004-2005 (6 cases), during which the public health response primarily involved trap-vaccinate-release (TVR) campaigns since ORV is considered ineffective in skunks (Leslie et al 2006; Rosatte et al 2009).

With the emergence of gray fox rabies in 2009, USDA is proposing that ORV baits be dropped in a 15-mile radius around locations where fox rabies cases have been reported. The 15-mile zone is a guideline based on previous ORV work done with gray foxes in Texas and may or may not be applicable to the terrain or home range of gray foxes in northern Arizona. If fully implemented, this 15-mile zone would potentially include areas within Sunset Crater Volcano (SUCR) and Walnut Canyon (WACA) National Monuments, two of the three NPS units collectively known as the Flagstaff Area Monuments (FLAG).

The primary objectives of deploying ORV baits in the Flagstaff area are:

1) Provide a rabies-free buffer around the city of Flagstaff and
2) Slow down the spread of rabies among gray foxes

To date, APHIS-WS has requested but not yet been approved for emergency funding to support these ORV activities in Arizona.

NPS Disease Outbreak Investigation Team (DOIT)

The NPS DOIT team was established in October 2008 to assist NPS units in addressing disease threats to humans and/or wildlife through a multi-disciplinary team approach.

For this investigation, the DOIT team was activated on April 16, 2009, following a written request by Pam Benjamin, the NPS Intermountain Region (IMR) Acting Deputy Associate Regional Director for Natural Resources, and concurrence from CAPT Charles Higgins and Dr. Margaret Wild, the DOIT team supervisors.

The specific charge for the DOIT team was as follows:

1. Address the human health risk from, and appropriate management response to, terrestrial rabies at the Flagstaff, Arizona area NPS units including SUCR and WACA.
2. Coordinate communication with the Coconino County Health Department, the Arizona Department of Health Services, APHIS-WS, and other internal and external stakeholders.
3. Provide a report of recommended response to the Region.

Assessment of Human Health Risk

The current rabies situation in the Flagstaff area is serious and warrants further public health intervention. As of May 29, there have been 3 human and 6 domestic animal exposures associated with rabies-positive wildlife in Flagstaff; at least 3 individuals have received post-exposure rabies prophylaxis estimated at a cost of over $2000 per person (Shwiff et al 2007; Kreindel SM et al 1998).

On April 7, 2009, the Coconino County Board of Supervisors declared a 90-day rabies quarantine within a “one mile buffer” area of Flagstaff, restricting roaming of pets and potentially allowing for the distribution of ORV bait within the quarantine area. Even if APHIS-WS does not secure funding to implement ORV, the Coconino County Health Department has expressed interest in

using county funds to purchase and distribute ORV baits, albeit in a much more limited manner (perhaps a one or two-mile radius buffer around Flagstaff).

Based on the current situation, it is unknown if an ORV program will be funded for the Flagstaff area in 2009 or if there will be a need to distribute ORV bait within NPS units or on other protected federal lands. If the FLAG management team decides to participate in an ORV program, the DOIT team would recommend that the park pursue a categorical exclusion to address the NEPA issues regarding ORV deployment (see NPS Management Response below). The need for a more complete EA addressing future ORV use in NPS units in the Southwest, including Arizona, would need to be explored.

Although the rabies situation in Flagstaff is serious, the DOIT team does not believe that an NPS "public health emergency" declaration is necessary, which according to the NPS Management Policies 2006 (8.2.5.1), states that "The saving of human life will take precedence over all other management actions as the Park Service strives to protect human life and provide for injury-free visits. The Service will do this within the constraints of the 1916 Organic Act."

Besides the distribution of ORV bait, other rabies interventions that could and should be considered include:

- Ongoing education of employees and visitors
- Prompt medical evaluation following exposures with potentially rabid animals
- Removal of wildlife that exhibit abnormal behavior and submission of tissues for testing
- Limiting translocation of carnivores due to the risk of spreading rabies to new areas
- Having employees who handle wildlife complete job hazard analyses (JHAs)
- Routine vaccination of employees' pets

NPS Management Response

Management of rabies is consistent with NPS Management Policies 2006. While the origins of rabies in North America remain uncertain, historical accounts suggest that rabies is likely exotic to the American Southwest (Connery and Wild 2001).

Currently there is no USDA or NPS EA regarding the use of ORV in Arizona. In light of the rabies outbreak in and around Flagstaff, APHIS-WS has determined that ORV use could be approved using a categorical exclusion under the Agency's NEPA Implementing Procedures 372.5(c): "Direct control projects conducted within a single season of work and on areas with impacts limited to a site-specific locality and its immediate area where the activities are not covered by an existing EA".

APHIS-WS is planning to develop an EA for New Mexico and Arizona this summer, and has offered to assist NPS in creating an EA for park units in those states. Discussions with the Environmental Quality Division (EQD), the Biological Resource Management Division (BRMD), IMR, and FLAG determined that ORV use in the summer of 2009 could be approved for FLAG using an NPS categorical exclusion as provided in CE 3.4 A.9: "At the direction of the NPS responsible official, actions where NPS has concurrence or co-approval with another bureau and the action is a categorical exclusion for that bureau".

Rabies Variants
All mammals are susceptible to the rabies virus. There are a number of rabies variants currently circulating in wildlife species in the U.S., and while each variant tends to be associated with a particular host species, a variant can "spill over" into other species. Spillover infection rarely initiates sustained transmission in the new species (Blanton et al 2008). The current variants and their distributions for 2006 are shown in Figure 2.

In the current rabies outbreak in Flagstaff, gray foxes and skunks have been the primary species that have tested positive. It is important to note that these species have been infected with a rabies variant typically associated with bats. This bat variant was similarly associated with a number of rabies cases in skunks in 2001 (Leslie et al. 2006).

Despite recent reports in the media, there is no evidence the 2009 Flagstaff-associated rabies virus is potentially transmissible animal-to-animal via casual or close contact. All rabies viruses, including this variant, have never been documented to spread any other way than through contact with the saliva, spinal fluid, or brain matter of an infected animal (Levy C, personal communication). Of these exposures, animal bites still remain the most efficient mode of transmission. What is atypical in the Flagstaff area cases, however, is the virus's adaptation from *Chiroptera* to *Carnivora*. This adaptation may have facilitated sustained transmission of the bat variant among skunks (Leslie et al. 2006) and gray foxes. Whether the bat rabies variant will become established in the gray fox or skunk populations is unknown, but is another important concern driving the potential use of ORV in the Flagstaff area.

ORV has been shown to be effective in protecting terrestrial rabies-reservoir species of wildlife from any of the rabies variants, including this bat variant, with one important exception. The oral preparation of the vaccine does not appear to provide protection to skunks. A much lower percentage of skunks that ingest the vaccine show evidence of an antibody response to the vaccine relative to the percentage of other species tested. This raises the concern that while the use of the available ORV could be effective in limiting the spread of rabies in gray foxes, it may not have a direct effect on limiting the spread or incidence of rabies in skunks. Such limitation should be a consideration in the decision to use ORV, but may not prevent such use.

The use of ORV in this situation is likely to benefit wildlife health overall, especially of gray foxes and other canids, despite the potential low efficacy in some species that may not mount a consistent immune response (e.g. skunks) or may not ingest the bait (e.g. felids). Monitoring of wildlife species for ORV efficacy would be ideal, and should be done if possible, but is not likely feasible given the limited funding available in this situation. In lieu of ORV, TVR of skunks and/or gray foxes could be considered as a management option but would also likely be cost-prohibitive.

Communication
Throughout this investigation, the DOIT team communicated with and/or received data from the following agencies and individuals:

Coconino County Health Department
Sabrina Ferrat, BS, Animal Management Supervisor

Mike Callahan, PhD, MPH, Epidemiologist

Arizona Department of Health Services
Craig Levy, MS, Program Manager, Vector-Borne and Zoonotic Diseases
Elisabeth Lawaczeck, DVM, State Public Health Veterinarian

USDA APHIS-WS
David Bergman, State Director, Arizona
Krista Wenning, Rabies Project Coordinator, Arizona
Beth Kabert, Rabies Environmental Coordinator

NPS
Diane Chung, Superintendent, FLAG
Sharon Kim, Acting Chief of Resources, FLAG
Pam Benjamin, Acting Deputy Associate Regional Director for Natural Resources, IMR
Chris Turk, Environmental Compliance Officer, IMR
Sandy Hamilton, Acting Branch Chief, Environmental Planning and Compliance, EQD, WASO
Margaret Wild, DVM, PhD, Chief Wildlife Veterinarian, BRMD, WASO

The DOIT team will continue to communicate with these and/or other individuals as this issue evolves.

Conclusions and Recommendations

1. The emergence and rapid spread of animal rabies in the Flagstaff area, particularly among gray foxes, poses a significant human health threat.
2. In addition to ORV, other rabies prevention activities and interventions are prudent for protecting both public health and wildlife health.
3. ORV is likely to control rabies spread among gray foxes, but its impact on rabies prevalence among skunks and other species in the Flagstaff area is unknown.
4. If a decision is made to deploy ORV baits in the Flagstaff area, several critical issues still need to be addressed, including a) the size of the treatment area, b) the importance (from a disease control perspective) of including specific federal lands (e.g. National Forests, NPS units), and c) ensuring that all NEPA compliance issues have been adequately addressed.
5. If necessary, Categorical Exclusion 3.4 A.9 should be considered prior to approving ORV use on NPS lands in 2009.
6. The DOIT team will continue to work with the FLAG management team, the IMR, and other NPS partners on this important public health issue.

/s/ DOIT Team

CDR David Wong, MD, Medical Epidemiologist, NPS Office of Public Health, david_wong@nps.gov
Kevin Castle, DVM, Wildlife Veterinarian, NPS Wildlife Health and Management Team, BRMD, kevin_castle@nps.gov
LCDR Adam Kramer, MPH, Environmental Health Officer, NPS Office of Public Health, adam_kramer@nps.gov

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Figure 1a. Locations of animal rabies cases (n=23) in the Flagstaff Area, Arizona—January 1-May 29, 2009, Large-Scale Map

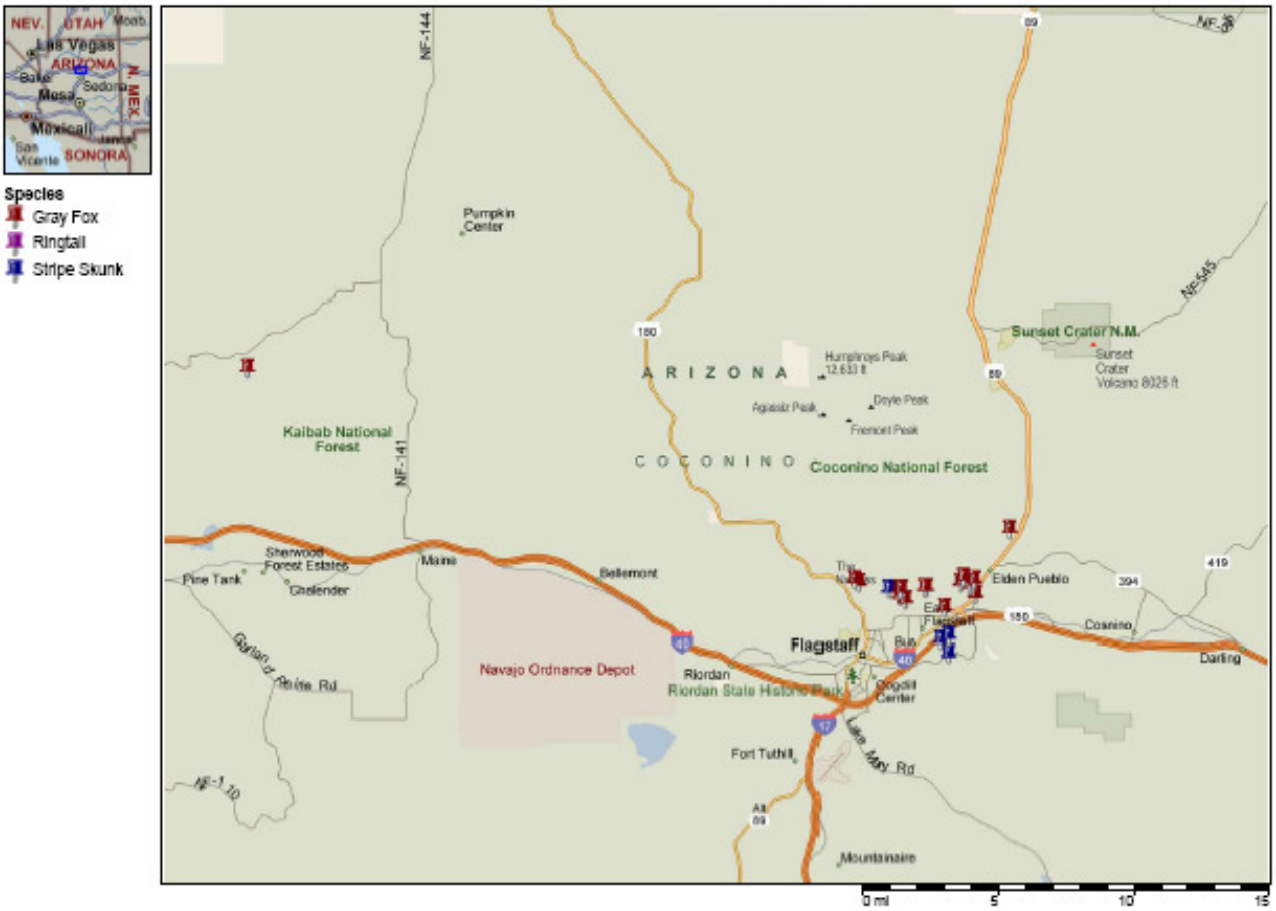

Figure 1b. Locations of animal rabies cases (n=23) in the Flagstaff Area, Arizona—January 1-May 29, 2009, Small-Scale Map

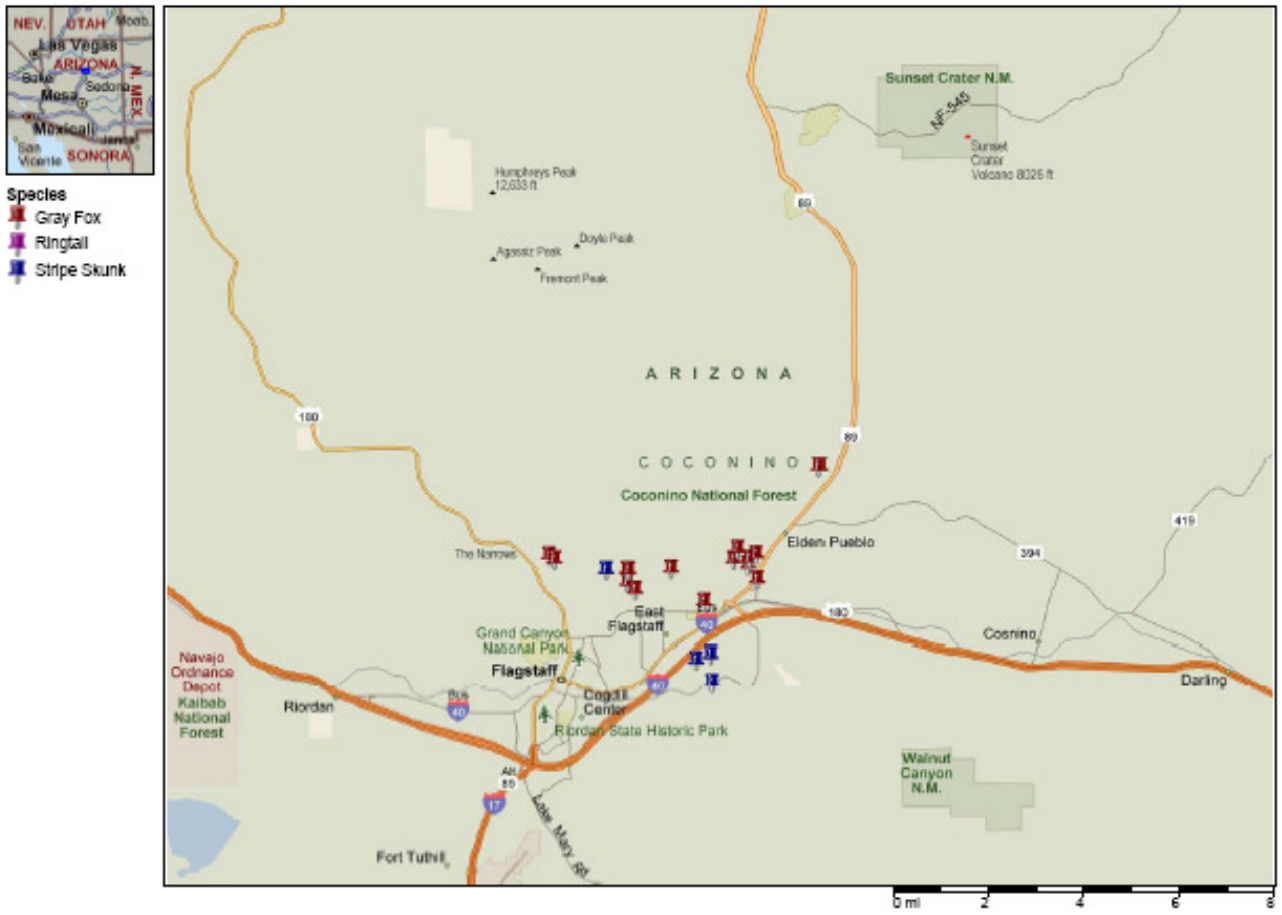

Figure 2. Cases of rabies in foxes, raccoons, skunks, and bats—United States, 2006